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ABSTRACT

This paper discusses applications of the systems approach and of resource-based learning in Technical and Further Education; examines existing educational delivery systems and the potential impact of new technological developments on those systems; and considers a number of initiatives which could be taken to use technology to improve the efficiency and effectiveness of the learning/teaching process. It is argued that technology can be applied to reduce some educational costs, increase the effectiveness of instruction in many training-oriented subjects, and extend learning opportunities to the community at large, while providing more selective coverage to special user groups. Such applications of high technology as computer-based education, instructional television, and mass media are discussed, as well as the potential impact of personal computers, videodisc, Teletext/Viewdata, cable television, and satellite communications. The use of relatively unsophisticated technologies--in-house produced resource materials, community radio, and community television--are described to indicate the level of educational technology that can be developed and utilized at college level. The implications of the new technologies for educational content and methodology are discussed and it is concluded that the introduction and integration of information technology into TAFE learning and teaching programs must be given high priority. A list of 22 references is provided. (CHC)

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APPLICATIONS OF EDUCATIONAL TECHNOLOGY IN TAFE

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This study is one of a series of papers prepared on request of the Director-General of Further Education for submission to the Committee of Enquiry into Education in South Australia. It has been prepared in consultation with a number of staff of the Department of Further Education but responsibility for the content rests with the authors.

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1. INTRODUCTION

> "Any discussion of educational technology must begin with these constraints. Realistically, in ten years, we will have one-half of the fiscal resources [for education] that we have today: one-half of the salaries, the facilities, the books, the equipment, the maintenance, the transportation, and the administrative resources. One-half real dollar loss in ten years assumes an average erosion of 7% per year; that is, losses from inflation, salary hikes and recession will overbalance any gains from tax monies and other sources by about 7% per year over the next ten years." (1)

It is possible to dispute the degree of precision of the above forecast by Christopher J. Dede, Associate Professor of Education and Future Studies at the University of Houston. However, there is little reason to doubt that in general terms his forecast is indicative of current trends in educational funding, in Australia as well as in the United States, nor that the "short-term" problems currently facing education in this country may well prove "long-term" and possibly irreversible.

It is reasonable to assume:

(a) that inflation on average will continue at something like its present level (9-10% p.a.) for the foreseeable future (5-10 years);

(b) that during this period education cannot expect to maintain the same high priority in terms of funding that it has received in the recent past;

(c) that total budget allocations for education will therefore decrease in real terms, and perhaps in absolute terms as well;

(d) that education is in fact facing a long-term economic crisis, and that this is due in large part to its highly labour-intensive nature (approximately 83% of total recurrent costs in D.F.E.).

In this situation TAFE authorities are faced with a limited number of options, each requiring hard decisions. They can:-

(a) attempt to maintain existing services at lower cost (e.g. by increasing class sizes, reducing support for libraries, etc.); or

(b) reduce existing services by dropping particular areas of responsibility (e.g. remedial and/or adult literacy programmes, enrichment courses, etc.); or

(c) endeavour to improve the cost effectiveness of education programmes by the introduction of new approaches to learning and teaching (e.g. through the use of technology).

Under option (a), programmes and services are progressively reduced each year (which is basically what is now happening). After a few years of this strategy, it can be expected that public confidence in TAFE will have been eroded if not destroyed, and no progress will have been made in dealing with the fundamental issues.

Under option (b), programme priorities are determined which necessarily reflect those of the government of the day and of the more influential group in society. Social need takes a subordinate place to political appeal. Again, such a policy will lead to potentially destructive conflicts between TAFE and a large part of its constituency.

This paper addresses option (c). It discusses applications of the systems approach and of resource-based learning in Technical and Further Education; examines existing educational delivery systems and the potential impact of new technological developments on those systems; and presents for consideration a number of initiatives which could be taken to use technology to improve the efficiency and effectiveness of the learning/teaching process. It does not suggest that machine instruction can provide a universal panacea for the problems facing education. It does, however, argue that technology can be applied to reduce some educational costs (in the longer term if not immediately); to increase the effectiveness of instruction in many training-oriented subjects; and to extend learning opportunities to the community at large, while providing more selective coverage to special user groups.

2. EDUCATIONAL TECHNOLOGY

2·1 DEFINITIONS

In its more familiar sense, the term educational technology means "the media born of the communications revolution which can be used for instructional purposes alongside the teacher, textbook and blackboard.." This paper adopts the extended definition used by the Commission on Instructional Technology in the United States, as "a systematic way of designing, carrying out, and evaluating the total process of learning and teaching in terms of specific objectives, based on research in human learning and communication, and employing a combination of human and non-human resources to bring about more effective instruction." (2)

More concisely, the Australian Society of Educational Technology has described educational technology as "the design, application, evaluation and development of systems, methods and materials to improve the process of human learning." (3)

This view of educational technology recognises the importance of integrating theory and practice and the development of :

(i) instructional systems (including courses and units of study);

(ii) instructional methods (including staff training and development programmes);

(iii) instructional media and materials (including the new electronic media and the whole range of print and non-print materials).

2·2 THE SYSTEMS APPROACH

A key element of educational technology is the adoption of the systems approach to the design and planning of learning. Kemp defines this approach as

> "the development of an overall plan incorporating the inter-related parts of an instructional process in a sequential pattern... It means the systematic design of instruction, based on knowledge of the learning process and on communications theory, taking into consideration as many factors and variables of the particular situation as possible, so that successful learning will result." (4)

Davies, in discussing educational technology and the systems approach to education, writes that

> "it enables the teacher, research worker or administrator to isolate out meaningful problems, select appropriate strategies for dealing with them, and then determine the effects that these strategies could or do have on the working of the overall educational system." (5)

An example of this type of systematic planning and design of course content and implementation within the Department of Further Education is provided

by the programmes developed for distance education at the Open College of Further Education. Like the Open University in the United Kingdom, the college has developed a team approach to course development, involving course writers, teachers, and print and media production staff. Another example is the systematic planning of the modules developed for training in Carpentry and Joinery, in which the Marleston College of Further Education has taken a lead.

A more comprehensive and methodical curriculum model using this approach has been developed by TAFE in Victoria. Known as the Instructional Systems Model for Vocational Education, it is described as "an integrated combination of resources, techniques and procedures, reinforcing efficiently the functions required to achieve specified learning objectives..."

2·3 INDIVIDUALISED LEARNING

Gagné and Briggs (6) writing about individualised instruction, note that the term has been used in the literature to refer to any or all of the following:-

Independent study plans
Self-directed study
Learner-centred programmes
Self-pacing
Student-determined instruction

Individualisation has been aptly described by Gibbons as

> "a liberal movement. It begins on the right with the amelioration of mass teaching, and shifts to the left by concentration on group practices, adaptation of subject matter to the individual, and finally, by emancipation of the student from the constraints of education planned by others.... While one group of theorists continues the search for the perfect input to yield predicted outputs, the great majority argue that independence, self-direction, initiative freedom, and responsibility must be developed in students". (7)

Such a concept has particular applicability in TAFE, which must develop delivery systems flexible enough to respond to the learning needs of a wide range of individuals and social groups within the community.

2·4 RESOURCE-BASED LEARNING

Any discussion of individualised learning assumes the provision of adequate resources (both human and material) to support the systematic development and maintenance of such a programme. The term Resource-based learning is now commonly used to describe programmes which place heavy reliance on learning materials, whether they be purchased commercially, developed by a central curriculum body, produced by the individual teacher, or a combination of all three.

Davies has pointed to the danger in thinking of resources "as purely

physical things to be organised from or added to an existing situation". He continues:

> "It is clear that the ideas of resource-based teaching or learning can be looked at as a series of much more powerful concepts which use physical resources to achieve definite ends. A resource-based approach inevitably modifies the teaching and learning situations in any school in which it is introduced; indeed in most of the schools apparently getting most benefit it is probably true to say that the whole school environment - staff, buildings, equipment, planning - is a resource centre so far as the learner is concerned." (8)

In other words, a resource-based approach requires the student's work to be literally based on learning from resources of various kinds, of which the teacher is but one among many. Its implementation requires the acquisition of new skills of resource organisation on the part of the teacher, a large and well-organised collection of learning materials, and a suitably designed learning environment.

2·5 SOME PRESENT APPLICATIONS OF INDIVIDUALISED AND RESOURCE BASED/ASSISTED PROGRAMMES IN TAFE

(a) In Victoria many TAFE Trade areas are now making use of a self-paced approach in conjunction with module structures. At Richmond Technical College Self-Paced Programmed Instruction in Panel Beating has been operating most successfully for a number of years. Although initially there were minor teething problems (mainly teacher acceptance), latest reports indicate that this approach is now contributing to a more educationally effective learning programme. At Richmond there has also been some development in the automotive and sheetmetal areas, and self-pacing techniques are used in some modules with the ultimate aim of covering the whole curriculum. All these programmes are being trialled and used to varying degrees in other Colleges throughout Victoria. These developments in Victoria are directly related to the Instructional Systems Model for Vocational Education referred to in section 2.2 above.

At Richmond Technical College there are three qualified Educational Technologists who all have Graduate Diplomas in Educational Technology from Toorak State College. They work closely with other teaching staff as part of the College Educational Services Unit, developing self-paced, resource-based programmes and assisting in their implementation. Other large Technical Colleges in Victoria have at least one qualified Educational Technologist on the staff and in some cases more than one. In contrast only three Colleges (excluding the Open College), in South Australia have even one Educational Technologist on their professional staff at the present time.

(b) In the Department of Further Education there are few, if any, courses using a self-paced approach as highly developed as in Victoria. At best the areas that can be identified appear to fit more into the category of resource-assisted rather than resource-based programmes. For example Hairdressing, Plumbing, Automotive, and Carpentry and Joinery are four areas which place considerable reliance on centrally developed and college produced learning materials to support the teaching programme. On the other hand, the Open College offers many courses through a highly developed

Distance Education delivery mode which can be categorised as Individualised or Resource-Based. Through the Centre for Resource Development, which is responsible for the development of all print and audio-visual learning materials, the OCFE is developing a course teams approach similar to that of the Open University, where Course Writers, Educational Technologists and Producers are systematically planning and developing course materials.

2·6 CONCLUSIONS

The systems approach to education, utilising the concepts of individualised and resource-based learning, provides the opportunity for teachers to become more professional in their practice and improve the quality of their teaching. McBeath considers that it enables them "to look beyond resources as media units and see them as part of the total process of education, with a potential to influence learning in different ways." (9)

It is evident that the systems approach has secured a firm foothold, particularly in TAFE, in recent years. This is exemplified by the adoption of the Instructional Systems Model for Vocational Education in Victoria (referred to above), and its application in that state to the majority of trade areas.

Although applications in South Australia are less extensive at the present time, there is every reason to believe that they will develop in scope and coverage, if only as a reaction to external factors. These include the need for changes in vocational curricula to match technological change in industry; the establishment of core curricula at a national level in various trade areas (e.g. the electrical trades) and the consequent demand for a more standardised approach and the development of resource materials that can be used in all states; the influence in this latter area of the TAFE National Centre for Research and Development which is being established in Adelaide; and increasing recognition of the fact that a technological approach to education can prove to be both cost efficient and educationally effective.

3A. 'HIGH TECHNOLOGY' APPLICATIONS * — TODAY

It is now necessary to consider actual and potential applications of technology, in the more familiar sense of communications equipment and media, to the process of education. As the systems approach has become more widespread in education, so society at large has continued to expand its technological capabilities. This in turn can be expected to lead to increased pressure on educators to make more use of technology (in both senses), in part for economic reasons and in part to provide the intensive, sophisticated training and socialisation necessary to enable the community to cope with a high technology environment. This has particular implications for TAFE and its delivery systems.

3A·1 COMPUTER-BASED EDUCATION

No discussion of 'high technology' applications in education can avoid mention of the computer's growing role. First utilised in the United States in the 1960s as an adaptive and flexible medium for conveying programmed instruction, computers are now used in a variety of ways - for research, for teaching computing, for administrative purposes, for the management of learning, and last but not least, as learning resources or media in their own right.

(a) The research and administrative uses, although of great and growing importance, are outside the scope of this paper and will not be considered here. Of the remaining, more directly educational uses the most widespread is for teaching courses in computing science, programming, and computer education / appreciation. The teaching of computing is now well established in the universities and the technology-based CAEs. Computing has also entered the curriculum of many TAFE Colleges and secondary schools. In the Department of Further Education several metropolitan Colleges are now using mini-computers in the teaching of the main business and technical computer languages. Other present applications are in mechanical engineering, electronic engineering and surveying.

(b) Computers are also being used increasingly for the management of learning. The most extensive use of 'computer managed learning' (CML) is for the marking of tests and the processing of examination results. Other practical uses include the diagnosis of student weaknesses and the prescription of specific learning/teaching activities based on a student's previous performance. The computer's role here is not to present teaching materials, but to assist both teacher and learner in the management of learning. Britain's Open University system of distance teaching to some 50 000 students is highly dependent upon using the computer for such diagnostic, evaluative and administrative tasks.

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* Note: for the purposes of this paper the term 'high technology applications' describes those educational programmes and systems requiring sophisticated and expensive electronic/mechanical equipment for their production, distribution and/or utilisation.

(c) Finally, computers are used as a medium for assisting learning. A familiar example of 'computer assisted learning' (CAL) is 'computer assisted instruction' (CAI) of the 'drill and practice' and 'tutorial' varieties. In post-secondary education, however, the most extensive use is for simulation, modelling, calculating, and problem-solving - in a sense, the computer acts as a laboratory for trying out and testing ideas. According to Hooper, the use of the computer as laboratory "allows the student to:

- get firsthand experience of more realistic problems and experiments without the student getting lost in mathematics and data analysis;

- explore and practise numerical approaches to problem solving, thus complementing traditional analytical procedures, and given these numerical techniques, the student can then tackle the more realistic problems;

- integrate different approaches and disciplines by being able to manipulate situations and models which are much more complex than the ones used in the normal, pre-computer, 'chalk and talk' classroom;

- close the gap between theory and practice, lecture and lab session, by being able to try out in practice theoretical concepts, changing, for example, the input values and parameters of a given model to test a given hypothesis;

- develop problem-solving skills particularly with regard to decision-making;

- perform simulated experiments." (10)

CAL has also been applied widely for training purposes in industry. The flight simulator widely used for pilot training is a well known example. Many of the simulators now in use embody inside the computer a tutorial teaching capability, so that the student can get assistance and explanations from the machine as he works on the problem.

(d) Implications for Department of Further Education

No education authority can afford to ignore the inevitable introduction of computer based education (CBE) methods. The upgrading in the near future of computing facilities in a number of D.F.E. Colleges will enable a limited development of CAL to proceed and will provide teaching staff with improved facilities for scheduling teaching resources and managing learning activities. This will carry important implications for both curriculum and staff development.

First, any course which proposes to incorporate CBE methods will need to be systematically designed and planned in accordance with clearly defined objectives. Attention will also need to be paid to methods of evaluation and provision of adequate resources to implement the programme.

Second, teachers will need to accept a change in role as managers of learning events, with formal class instruction giving way to more individual or group tutoring.

Neville Williams, Acting Senior Lecturer in Business Studies at the Panorama Community College of Further Education who has studied the implementation of CBE systems overseas, sums up the potential benefits in the following terms:

> "Very few formal studies have been made, but intuitive responses where CBE systems are implemented suggest that teacher productivity is higher, dropout rates are lower, students like the courses better because of the better feed-back they obtain, and some courses are able to be made more relevant. The range of courses in which CBE methods may be used is limited only by the teachers themselves". (11)

3A·2 INSTRUCTIONAL TELEVISION

A second major application of 'high technology' in education is Instructional Television (or ITV). Under this broad heading are grouped several distinct technologies: over-the-air telecommunications; copy delivery systems; and cable transmission. Of these, only the first two have been utilised in Australia to date. However, following the Commonwealth Government's recent approval in principle of cable TV, this form of transmission, with its capacity for providing two-way interactive communications, has the potential to revolutionise the delivery of ITV services in future. (see section 3B.4 below).

(a) The technology most widely available for the distribution of ITV programmes is broadcasting - in particular, the over-the-air channels provided by the Australian Broadcasting Commission. Unlike the British Broadcasting Corporation, however, which has a special section within its Education Department concerned with the production of Continuing or Further Education programmes, the ABC's formal educational programming is confined to the primary and secondary sectors. The only instructional programmes intended for post-secondary audiences broadcast on a regular basis in Australia are those transmitted by the University of New South Wales educational TV station VITU in Sydney. The possible extension of existing broadcast services to include TAFE programmes is discussed in section 3A.3 below.

(b) A variant form of over-the-air transmission is provided by Instructional Television Fixed Services (ITFS), found in many U.S. cities. It is a low power system offering up to 4 channels of simultaneous transmission, but with a limited range of about 25 miles. Its multi-channel delivery system allows for the 'targeting' of specific audiences and for multiple repetition of programmes.

Although a relatively low cost technology when compared with conventional broadcasting, the installation of an ITFS system still represents a substantial capital investment, and thus a long-term commitment to its use. With the new technologies now emerging such a commitment does not seem to be justified.

(c) Copy delivery systems are those which deliver programmes, in the form of video tapes or cassettes, to users via a physical distribution system rather than electronically. The video programmes are often accompanied by supplementary teaching materials and are designed for

classroom use. The videotape cassette is the most flexible of all ITV programme delivery systems providing the teacher with the opportunity to choose the right programme for use at the right time and place, and allowing him/her to control its presentation, stopping, starting and replaying material at will. Copies of the cassettes can also be held in the library/learning resource centre for individual student viewing.

The Department of Further Education has made a substantial commitment of resources to video cassette production and utilisation. Educational Multi-Media, a unit of the Open College's Centre for Resource Development, operates a video production studio at the College's Kilkenny Campus. Lecturer-producers and experienced technical staff work together with subject specialists to produce programmes directly relevant to a range of departmental courses. This relevance is ensured by the approval process: programmes originate with a request from a lecturer or lecturers in any College, or from a curriculum group; this is then investigated by lecturer-producers on behalf of the Projects Task Force, the investigative arm of the Production Commitments Panel; the Panel has the final responsibility for establishing programme priorities in terms of educational need, and for approving production.

Users are supplied with a descriptive catalogue listing all the programmes available, and supplementary lists are issued through "Interface", a serial publication of the Centre for Resource Development. A master tape of each programme is maintained by Educational Multi-Media, and copies are supplied to individual Colleges on request. All DFE Colleges now have video playback facilities (a video cassette recorder and monitor), and most maintain libraries of the programmes of particular interest to them. An advantage of videotape is that, as programmes become outdated or obsolete for teaching purposes, new programmes can be recorded on old stock, thereby reducing tape costs.

Many DFE produced programmes are utilised by other education authorities, including the Education Department, Colleges of Advanced Education, and TAFE in other States. Marketing and sales are handled by the S.A. Film Corporation, which legally holds copyright in all programmes. The establishment of the TAFE National Centre for Research and Development can be expected to encourage the growth of resource sharing and the exchange of resource materials (including video) between states.

3A·3 THE MASS MEDIA

Until recently, with the exception of a few educational radio stations associated with tertiary institutions (such as Radio 5UV at the University of Adelaide), little attempt has been made in Australia to utilise the mass media as a significant component in post-secondary education provision. However, present financial constraints, together with current and proposed developments in telecommunications and public broadcasting, provide an incentive for TAFE authorities to give serious consideration to their use - in particular as a means of extending the opportunity of access to either formal or informal education programmes to all adults in the community.

In many countries the mass media now form an integral part of a total teaching and learning delivery system which combines broadcast components

with other learning resources and experiences, such as tutorial and discussion groups, special reading materials and exercises, correspondence work, and so on. The Open University in the United Kingdom, and the Ontario Educational Communications Authority in Canada, amongst others have demonstrated the effectiveness (in both cost and educational terms) of bringing the classroom to the learner via the media.

In addition to their use in formal education programmes, the mass media can also be used informally to augment and enrich learning experiences. For example:

(a) effective use can be made of what is already broadcast on national and commercial television and radio. High quality prime time TV programming offers valuable learning opportunities which at present are largely ignored by adult educators in Australia. In North America and the United Kingdom, in contrast, broadcasters and educators work together to produce study guides and curriculum packages to accompany major series such as "Civilisation" and "Life on Earth", as well as one-off 'specials' like "When the Chips are Down". Radio programmes can be used in similar fashion.

(b) broadcast courses can be developed for those who are unable or unwilling to attend educational institutions, or who prefer to study at home in their own time. Subjects such as family budgeting, opportunities for women, self defence and various craft subjects would be well suited for development in the first instance - for example, in country areas with the cooperation of local/regional radio and television stations.

The inclusion of a further education segment in 5UV's Over-Sixties radio programme for a short period in 1979 illustrates the possibilities of this approach.

(c) Courses by newspaper are becoming increasingly popular in North America and a pilot project by the Open College of Further Education is currently exploring this idea on a small scale. The project, in the Riverland, uses newspaper articles to motivate potential learners to enrol in College courses. There is obvious potential to extend this application to other areas, both country and metropolitan, using the local press possibly in conjunction with local radio outlets.

In considering the use of the mass media as an alternative and/or supplementary delivery system to extend and widen community access to further education in South Australia, attention needs to be paid, at the same time, to the availability of 'back up' services such as supporting print materials, home study groups, study centres, tutors and so on. The Department of Further Education is particularly well placed to provide these services, with its network of Colleges throughout the State, and the specialised distance education facilities of the Open College of Further Education (including its sophisticated print and multi-media production units).

A more detailed discussion of the potential role of the broadcast media in TAFE appears in the discussion paper 'Educational Broadcasting and TAFE'. prepared by Department of Further Education for consideration by the Australian Education Council at its 1980 meeting and is available from the Educational Resources Branch.

3B. 'HIGH TECHNOLOGY' APPLICATIONS – FUTURE TRENDS

The past quarter century has seen the development and widespread application of transistors, microprocessors, lasers, and personal calculators, to name but a few of the more spectacular achievements in electronics which are forming the basis of a new, information-based society. It has also seen men walk on the moon and send space vehicles to the distant reaches of the solar system. Given the accelerating pace of technological change, the achievements of the next 10 years can be expected to be even more spectacular, and their effects more profound. Their impact on education will inevitably be far-reaching - and if education authorities are to engage in meaningful long-range planning and preparation for the changes to come, it is essential that they should have an understanding both of present realities and of future prospects and problems.

In terms of technology and education, the probable future for the eighties is to be found in an extension of current directions, but on an increasing scale as technology and software become cheaper and human resources more expensive. Technological developments in, for example, micro-electronics, fibre optics, and lasers, will create cheap, mass-produced equipment with the potential to revolutionise instructional delivery systems. The microprocessor revolution will continue and programmable personal computers will become as common as personal calculators; media materials production will be simplified by cameras recording images digitally rather than on film, by voice actuated word processor/photo composition systems and by computer graphics; videotape and videodisc technology will replace the conventional 16 mm film, and satellite and microwave telecommunications will link the remote rural dweller with the inner-city inhabitant in a single distance learning system.

In this section it is proposed to examine the potential impact of some of these (already existing) technologies on education, and particularly on TAFE, in the imminent future.

3B·1 PERSONAL TEACHING COMPUTERS

In the 1960s, in anticipation of a boom in the computerisation of education, several affiliations between major engineering and publishing firms took place - e.g. RCA with Random House, and General Electric with "Time". However, the education/technology combines reportedly found the going "financially intolerable" - developmental, hardware and software costs all proved excessive, and the expected mass market did not eventuate. Consequently the introduction of computers into education has proved a slow and difficult process.

There is every reason to believe that the advent of micro-electronics will radically change the situation in the very near future. Inexpensive desktop, programmable personal computers are now available with the capacity to undertake semi-sophisticated computer-assisted instruction. The instructional modes that can be programmed include:

(a) tutorial approach - the computer presents material, asks questions to determine assimilation by the student, and corrects any misunderstandings;

(b) inquiry approach - the student asks for specific information, the computer responds with relevant data;

(c) dialogue - the student asks a general question, the computer provides a complex answer, leading to further questions by the student;

(d) explanation/interpretation - the computer presents complex learning material and responds to general questions.

Such computers can also be coupled to other learning devices, such as TV sets, video and audio cassette playback units, videodiscs, or slide/tape packages, to provide an integrated learning system. Using this type of instruction, many different computer programmes and data sets could be produced, distributed, and plugged into computers as needed.

An even greater impact can be expected from the pocket teaching computer now under development. In Evans' view, these pocket computers, no larger than the average pocket calculator, and selling at approximately the same price:

> "will, in the course of the 1980s, transform the educational system and at the same time create a new industry to capitalise on this development. Pocket calculators ... are very important straws in the wind, and the speed with which they have swept through the Western school system - while educationalists are still standing around uneasily musing whether they are a good thing or not - is an indication of the shape of things to come". (12)

Already pocket teaching computers operated off micro-processor chips with read-only memories of a hundred or more kilobytes of information (the equivalent of thousands of English words) are being manufactured. Their storage capacity is increasing exponentially, and by the mid-eighties it will be possible to pack entire language dictionaries into these devices. The micro-computer and its associated cassette tapes may well replace the printed book in commercially-produced language courses. Although the language application is possibly the one for which such computers are most easily programmed, their flexibility of function is such that they can be used equally well as drill and practice aids in mathematics, as personal information systems, etc. Being essentially all-electronic, they are highly reliable in operation, easy to mass produce, and their low cost will ensure mass sales.

The flexibility of the new generation of computers, large or small, is, says Evans, virtually infinite, and the range of tasks they can perform is limited only by the range of programmes which can be written for them. The implication for TAFE is that it is necessary to identify now those areas in which computer-aided learning can be most efficiently and effectively introduced. The eventual outcome may well be that, broadly speaking, training ('limited range of right answer' learning) is carried out in the main by machine, while educating ('multiple right answer' learning) remains largely the responsibility of people.

3B·2 VIDEODISC

The videodisc is a recent development in programme delivery systems, and is only now coming on to the Australian market. The technology is being developed independently by a number of competing firms, and as a result several incompatible systems have emerged. These can be grouped into two main categories:

(a) optical systems which use a non-contact, minutely focused light beam to read information stored on the disc; and

(b) contact systems similar to the needle technique used in playing audio discs.

Optical systems permit both linear playback of video programmes and access to individual frames which can be "frozen" indefinitely. With a storage capacity of 54 000 frames on each side of the disc, this is a feature of special interest for many educational objectives. Contact systems allow only linear playback.

The use of videodisc in education will depend to a considerable extent on the availability of suitable programmes produced in sufficiently large runs to make possible very low unit costs. It seems likely that one consequence will be the replacement within the next 5-10 years of the standard 16 mm educational film by videodisc - for example, it is estimated that the purchase price of a disc would be no more, and possibly considerably less, than the present transport cost of lending one film twice from the Film Library in North Adelaide to a distant country centre.

Videodisc manufacturers envisage a number of educational uses for the technology, including audio-visual instruction, computer-based instruction, and library-archive storage. With the 'industrial' educational mode coupled to an interactive micro-computer, the potential exists to design programming for use in a non-linear instructional sequence, and which could substitute for many group teaching areas. Given the high programming and production costs involved, this is most likely to take place in those subjects with a mass market potential. In the short term at least, the videodisc is unlikely to find wide applicability in TAFE, with its many specialised vocational areas of study. Some aspects of business studies, however, could well be selected for early programme development.

3B·3 TELETEXT / VIEWDATA

'Teletext' is the generic term used to describe an additional transmission of alphanumeric data and simple graphics inserted into the vertical image of the television programme signal. This information is then displayed on the screen of the TV receiver through the use of a special decoder.

Teletext was originally developed by the British Broadcasting Corporation in 1971. Since then, both the BBC and ITV have developed teletext services (known as 'Ceefax' and 'Oracle' respectively) offering up-to-date news, sports, weather and a wide range of other information services. Both services provide up to 800 pages of captions and words, and the only cost to the user is the hire or purchase of the receiver and decoder.

Australia's first teletext service is already operating in Sydney, where ATN-7 provides N.S.W. viewers with four 'Magazines'. Magazine One carries news, sport and weather; Two covers theatre programmes, recipes and other general interest material; Three has technical and background information about teletext itself; and Four provides TAB information on racedays.

Viewdata is a comparable type of information service carried over telephone lines, for which the user pays local call rates and a page charge. Unlike

teletext, it is a two-way system and the user is able to interrogate the data base by means of a keypad to obtain a specific item of information. It also requires a video display terminal or specially adjusted TV set to display the information.

The best known viewdata system is 'Prestel', developed over the past few years by the British Post Office and now operating in many larger cities and towns in the United Kingdom. There are currently more than 160 000 pages of data (a mixture of detailed information and advertising) available, and its capacity is limited only by the size of Post Office computers and the wish of information providers to use it. An international version of Prestel is now being trialled in Australia.

Similar systems are under development in a number of other countries, including France, where a hybrid system known as 'Antiope Videotext' caters for both teletext and viewdata. The French Post Office is reportedly investigating a proposal to give away 20 million TV sets adapted to Antiope - both to save the cost of printing their telephone directories and to gather increased revenue from use of the system.

Considerable attention is being paid overseas to the extension of screened-data techniques to education. The existing systems can be applied as supplementary teaching aids in certain areas - for example, both teletext and viewdata provide information of use in business studies and general studies, with their financial reports, news headlines, and current affairs. Prestel, with its two-way communications and much greater capacity, is already in use in some British academic and public libraries for retrieving up-to-date directory information. It is possible that in a few years time much current reference material (including, for example, prospectuses for colleges and universities) may only be available in this form.

More sophisticated educational applications are in the offing. In the U.K., an experimental 'telesoftware' system has been developed in conjunction with the ITV Oracle system, whereby computer programmes can be broadcast via the teletext pages to an enhanced teletext decoder lodged inside a TV receiver. The decoder contains a microprocessor memory which allows it to retain the programme which can then be run inside the 'intelligent' TV set, using the keypad as a keyboard. The concept has been adapted for viewdata systems enabling local viewdata terminals to communicate with a central main-frame computer via the telephone line. Since the line need only be in use for the length of time necessary to transmit the programme, there are significant cost savings for educational users.

In Canada the federal Department of Communications has developed a highly sophisticated screened-data system known as 'Telidon', which combines alphanumeric text with an advanced graphics capability. The Ontario Educational Communications Authority is conducting a series of field trials which aim to integrate the broadcast and interactive transmission modes, in terms of joint use of facilities, interconnections between data bases, and evaluation. The OECA anticipates that eventually the range of educational services provided will include:

curriculum-linked information/illustration,
programmed learning sequences,
appraisal instruments,
dissemination of project reports,
updated information in specialised fields,

lists of available extramural and intramural courses,
off-hours delivery of educational materials,
career information, etc. (13)

Telidon was demonstrated in Australia last year, using the Hermes communications satellite to connect with data bases stored on a computer in Toronto.

The sophisticated graphics capability offered by systems such as Telidon provides particular opportunity for educational applications in such areas as: illustrations in mathematics, science and technical subjects; comparative charts in economics and statistics; maps and profiles in geography and surveying; drawings and cartoons in adult literacy; and others.

As screened-data systems become established in Australia, there is no doubt that field trials will need to be undertaken to develop and evaluate possible educational applications. In the TAFE sector these could include use of the systems:

(a) as a replacement or alternative to conventional print activities, including an evaluation of the efficiency of electronic publication of specialised material;

(b) as a 24-hour information and retrieval system, releasing the learner from the restriction of college schedules;

(c) in computer-assisted and computer-managed learning;

(d) as a means of distributing career information.

3B·4 CABLE TELEVISION

In July of this year the Australian government announced approval for the introduction of cable and subscriber television, and directed the Australian Broadcasting Tribunal to hold a public inquiry into the best way of introducing the new system.

Cable television offers the educator several distinct advantages over broadcasting. First, the use of a cable for the distribution of signals produces outstandingly clear reception through the elimination of interference; second, it provides a very large number of channels from which to choose, enabling system operators to reserve channels for specific purposes such as education, local government and public access; and third, a cable distribution system has the capacity to provide two-way interactive communications, permitting inquiry and interactive response by the student.

Cable television already reaches into more than one fifth of homes in the USA which have TV - 16 million out of 78 million - and in Canada the penetration figure is now more than 50%. Some industry experts predict that the three major US networks will be reduced to 24-hour news services within 10-15 years, with all substantive programming being carried by cable.

Although some considerable time must elapse before cable systems become widespread in this country, they will eventually have a major impact in many areas, including education. Dedicated educational channels should

become available in all capital cities, providing what by today's standards are very low-cost alternative delivery systems direct to students' homes.

In schools and colleges wired for cable, teachers will have access to a diversity of channels limited only by the system's capacity and the institution's wiring budget. They will be able to choose from a range of programme sources including broadcast and cable TV programmes, videotape or videodisc recordings, and (where studio facilities exist) local 'in-house' productions; moreover, this local programming can be taped and distributed to other institutions linked to the same system.

On present indications it appears that cable will be in a position to offer Australian educators a delivery system capable of great flexibility and diversity before the end of the present decade. For the Department of Further Education, with its existing broadcast standard production studio at the Open College, and its 'in-house' facilities at other large colleges, the government's decision to sanction cable TV thus has a special significance. It will be well placed to take part "in jointly planning and undertaking research into and pilot studies of interactive educational television", one of the recommendations relating to cable TV in the "Telecom 2000" Report. (14)

3B·5 SATELLITE COMMUNICATIONS

In October 1979, following consideration of reports from a Task Force (1978) and Working Party (1979) on a National Communications Satellite System the Australian Government decided in principle to proceed with development of the system. It also established a Satellite Project Office to undertake the necessary detailed planning. A number of committees representing a range of potential users now operate at national and state levels to provide the office with information about user requirements, and to enable the office to keep users informed of planning developments. At the present time it is expected that the first Australian satellite will be launched early in 1985.

In the education field a National Working Party on Educational use of the satellite has been set up by the Conference of Directors-General of Education, and in South Australia a committee has been established by the Director-General of Education, with DFE representation, to examine possible uses by the state education authorities. Within the DFE the Educational Resources Branch has prepared a detailed report on potential departmental use of the satellite for the delivery of educational and administrative services. A copy of this report is available from the Educational Resources Branch.

Briefly, it concludes that, while initial use of the satellite by the Department is likely to be limited, and that consequently no long term commitment should be made at this stage, an on-going process of planning should be commenced <u>now</u> for potential use of the system in the longer term. It recommends setting up a series of field trials via land line for the delivery of educational services for adults in remote areas and in country towns, in conjunction with those now being undertaken by the Education Department in the schools area.

It also suggests that DFE should take the initiative in exploring with

other tertiary educational authorities the possibility of cooperating in joint production of learning resources for post-secondary education, and for cost-sharing in the use of the telecommunications system (terrestrial or satellite based) for their delivery.

Future teaching and learning methods will undergo far-reaching changes through the use of modern electronic technology in its communications, computing and production aspects. The five existing technologies described above represent no more than the first wave of this technological change, which, if properly applied, has the potential to bring about a significant improvement in the quality of instruction.

Communications technology is already creating new methods of teaching and placing additional demands upon the teacher. The management of access to information and knowledge will play an increasingly important part in the teaching process and teachers will need to develop proficiency in communications methodology.

As pointed out above, computer technology has already developed the capacity to implement computer-assisted learning on a massive scale. The computer also has the power to free the human teacher from many routine administrative and record-keeping tasks which do little to promote the learning process. He/she will then be able to concentrate far more attention on the learning needs of the individual students in his/her care.

The implications of the new technologies for the future development of TAFE are discussed in Section 5 below.

4. 'INTERMEDIATE TECHNOLOGY' APPLICATIONS

The late British economist E.F. Schumacher coined the term 'Intermediate Technology' to describe the introduction of relatively simple and unsophisticated equipment and techniques into developing societies which lack the capacity to assimilate immediately the highly developed and capital intensive technology of the modern industrial world. That is, intermediate technology, although considerably more productive than the indigenous technology, is still appropriate to the society in question and lends itself to small-scale use, without the negative side effects often associated with the sudden introduction of an advanced technology into a traditional social system.

In this section we use the term to indicate that level of educational technology which can be developed and utilised at College level. It makes full use of the knowledge and experience of existing staff, requires relatively low cost equipment, and seeks to increase the flexibility of College teaching systems and widen the range of learning activities to students, while retaining traditional educational approaches where appropriate.

4·1 "IN-HOUSE" PRODUCTION OF RESOURCE MATERIALS

The Centre for Resource Development at the Open College, as well as producing ITV programmes (i.e. 'high technology'), also produces overhead transparencies, photographs, 35mm slides, audio tapes, and slide/tape packs ('intermediate technology'). The central production of these resources allows for a high standard of production and systematic distribution to potential users in a number of Colleges.

In addition to this central facility, several larger Colleges have established, or are in the process of setting up, "in-house" resource production units. These range in complexity from simple materials preparation areas where teachers may produce slides, overhead transparencies, etc., to more sophisticated facilities for audio and video programme production. However, these College production units in no way duplicate the activities of the Centre for Resource Development. Whereas the latter is concerned with producing materials for use in a wide range of courses across the Department, the "in-house" units are producing learning/teaching materials primarily to meet specific needs within the individual College. Because of this localised approach it can be clearly identified as a different level of production.

A good example of "in-house" production is provided by the small educational technology unit at Marleston College of Further Education. Staffed by one lecturer, and housed in a converted classroom, it now has the capability to produce audio and video programmes and synchronised slide/tape packs, and is also extensively used by teaching staff for the production of 'low-level' materials such as overhead transparencies, slides and charts.

This unit has played a crucial role in the development of resource materials to support the introduction of a modular approach to Carpentry and Joinery in the College, as well as in other teaching areas. Its success can be

attributed in large part to the degree of involvement of the lecturers within the College in developing their own learning/teaching resources.

"In-house" production units have had an impact on the teaching programme in a number of other Colleges, including Panorama, Adelaide, Croydon Park, Regency Park, Elizabeth and Gilles Plains.

Although still in their infancy, these "in-house" production units are clearly fulfilling a different need from that of the Centre for Resource Development, and it is important that their continued development should be fostered. College level production has the following advantages:

(a) it is able to meet a lecturer's immediate needs without delay, and to provide resources directly relevant and appropriate to the need;

(b) it enables the adaptation and updating of existing resources to meet changing needs or circumstances;

(c) material needed to illustrate or describe a single concept or process, which may not justify a full-scale professional production, can often be quickly and inexpensively produced "in-house";

(d) materials produced by other sources (whether commercially or by a central production unit) are not always completely relevant to the local need, and may not always be available when required;

(e) where teachers are able to take an active part in the development or adaptation of learning resources they are more likely to incorporate them in their teaching programmes, and also to use these resources more effectively;

(f) finally, the ability to produce "in-house" a range of learning/teaching resources, albeit at a less professional level, alleviates the pressure on central production facilities.

The future development and effectiveness of these 'intermediate technology' production units is largely dependent on the appointment of suitably qualified and experienced educational technologists to the teaching staffs of larger Colleges. This step has already been taken in Victoria, where Educational Technology units are now operating in a number of the larger Technical Colleges, such as Preston and Richmond. The Technical Education Handbook describes their work in the following terms:

> "Educational technologists are concerned with the ways in which people learn best and how best to help them learn in those ways. Where learning resources are not available to match individual needs, every effort is made to produce either within schools and colleges or at a regional level the materials needed to accommodate an individual learning style or convey a particular concept.
>
> Educational technologists work closely with teachers to use or evolve programmes which will enable learners of all ages to work at their own chosen pace and by the most appropriate method towards mastery of a given skill or topic. As they promote alternative learning techniques, their work often involves instruction in the use of audio-visual equipment so that teachers are competent and confident enough to experiment with alternative methods of achieving given objectives and outcome." (15)

As similar units are developed in South Australian Colleges of Further Education, it is envisaged that they will assist subject lecturers with advice and training at a number of levels - e.g. by

(i) providing in-service training on the operation and maintenance of audio-visual production and utilisation equipment;

(ii) developing simple production skills to enable classroom teachers to produce their own overhead transparencies, slides, audio tapes, etc.;

(iii) advising lecturers on the availability of learning resources (both commercially and departmentally produced) and discussing methods for their effective utilisation;

(iv) assisting curriculum groups and individual lecturers on the systematic design, production and implementation of learning/teaching resources and packages for self-paced and/or resource-based programmes within the College.

Low cost, appropriate quality media production is now at the stage where both its development and utilisation can be controlled at the college - even the classroom level. (See Section 5 below). This opens the door for both teachers and learners to take part in the media production process - an important step in breaking down the mystique surrounding production equipment, and thus helping to facilitate the integration of media materials into College programmes.

4·2 COMMUNITY RADIO

Another form of Intermediate Technology which lends itself to utilisation by TAFE authorities at the College level is Community Radio. In April 1978 the Australian Government approved the development of Public Broadcasting as a distinctive third sector in Australian broadcasting, and announced that station licences would be issued in the following categories:-

- 'E' licences - to be issued to educational bodies intending to provide programmes of continuing and adult education, and aiming to enrich the cultural life of the audience;

- 'S' licences - to be issued to groups intending to provide programmes servicing a particular interest or group of interests (such as music);

- 'C' licences - to be issued to groups intending to provide programmes serving a particular community (suburban or rural).

The discussion paper 'Educational Broadcasting and TAFE, discusses the potential role of public broadcasting stations in TAFE. Here it will be sufficient simply to point to the possible use of local community (category 'C') stations by DFE Colleges.

A recent British White Paper on Broadcasting described the function of community or local radio as follows:-

> "Each station should have a general duty to inform, entertain and educate and each should have a special obligation to celebrate the particular quality of life in its locality. Local radio can provide

people with information and news about what is happening in their community and it can afford individuals and groups an opportunity to communicate with the communities to which they belong. In these ways, the local radio can bind a community together, nourish that which is distinctive about a community, and respond, in ways not open to the national networks, to the needs and wishes of the community and of the individuals and groups within the community it serves."

It is expected that category 'C' stations in Australia will play a similar role in their communities. Although the first 'C' licences have yet to be issued, at least two groups in South Australia - Blue Lake Community Broadcasters, Mount Gambier, and Para Broadcasters Association, Salisbury - are well advanced with their planning and expect to receive a licence within the next 12 months. In both cases the local TAFE College is represented on the planning committee, and in the case of Para Broadcasters it is intended that one of the Association's broadcast studios should be on the premises of Elizabeth Community College.

Community radio will normally be low-powered and low coverage, and programming will have to be tailored to meet the diverse needs of its particular geographical community. Stations will be under local community control, station staff will be largely amateurs and volunteers, and technical standards will be of less importance than the relevance of programmes to the listening audiences. In these circumstnaces the educational component must be informal in character, appealing to people with little or no recent contact with formal study, and in many cases significantly disadvantaged by their previous educational and/or life experiences.

The following are some of the educational programme options which could be considered for development on a community station:-

(a) adult basic education (e.g. support for literacy and numeracy programmes);

(b) community education (e.g. social and personal development of individuals and families, consumer affairs, health, legal problems, etc.);

(c) programmes developed by and for particular community groups (e.g. pensioners, women, youth);

(d) music (appreciation and performance by local College groups);

(e) talk-back programmes (with College counsellors and specialist teaching staff taking part).

The advent of community radio will provide TAFE Colleges with an unrivalled opportunity to diversify and extend their outreach programmes at relatively low cost, and to reach many sections of the community largely untouched by institution-based programmes. It is therefore most important that Colleges should be encouraged to participate in the planning and development of community radio stations, and that suitable in-service training programmes should be provided to develop broadcasting skills in College staff involved in programme production and presentation.

4·3 COMMUNITY TELEVISION

Community TV can only be discussed under the heading of Intermediate Technology if the costs of broadcast transmission are ignored. Nevertheless, there are an increasing number of community groups active in this area, and proposals for a three month community television experiment in four centres early in 1981 are under consideration by the Postal and Telecommunications Department. The projects in Sydney and Melbourne will make use of Special Broadcasting Service transmission facilities. In Perth, a grouping of Frevideo (a community TV association) with educational institutions is being developed. In Lismore, the Northern Rivers College is cooperating with the regional commercial channel 11-8 which is willing to provide transmitter downtime.

Westcom, a community TV cooperative in the western suburbs of Melbourne, which will take part in the proposed experimental project in Melbourne, has been granted access to the use of the colour television studio in the Footscray Technical School for production purposes. The management of the studio is to be shared by a group of local schools and by Westcom representing the community. This is seen as an exciting development in the move towards a permanent community TV service in the western region of Melbourne.

At least two such groups are understood to have been formed in Adelaide, and while it may be doubted whether there will be any significant development of community TV in South Australia in the near future, the advent of cable television could well give the movement a fillip in the latter part of the decade.

5. IMPLICATIONS OF THE NEW TECHNOLOGIES FOR T.A.F.E.

Ten years ago, in 1970, Alvin Toffler published his important and challenging analysis of the accelerating thrust of change in our time, "Future Shock". (16) His latest work, "The Third Wave: the Revolution that will Change our Lives", (17) has just appeared in the bookstores. In the intervening decade, literally hundreds of other futurological studies have appeared, some of them fanciful, others based on a rigorous examination of technological limitations, investment requirements, and slow social adaptability. A good example of the latter is "The Future With Microelectronics" (18) a report prepared by the Science Policy Research Unit at the University of Sussex for the British government.

Despite the variations in approach, a general consensus is emerging that, as the dust jacket of "The Third Wave" puts it, "a new civilisation is being created round us, though most of us are too bemused and overwhelmed to recognise it." This new civilisation is most concisely and accurately described as the "information-based society". Prof. Sir Ieuan Maddock, Secretary of the British Association for the Advancement of Science and a former Deputy Chairman of the National Electronics Council, describes it in these terms in his foreword to the University of Sussex study:

> "For as far as any outlook on the future of technology can reach - well into the next century, the ability to gather, record, organise, analyse and act upon information is going to be a dominant factor. What steam, steel, electricity was to the 19th century, information management and exploitation will be for the next half century if not very much longer. Not only is it the new 'raw material' of technology, it will inevitably become an essential ingredient of the fabric of the human society."

It is therefore not simply desirable but essential that educators should take stock of the rapid developments in information technology (linking electronics, computing and communications), their probable impact on employment and society at large, and the consequent implications for the future content and methodology of education itself. TAFE in particular, with its specific responsibility for the provision of technical vocational education relevant to the present and future needs of a changing society, cannot afford <u>not</u> to involve itself in the exploration and development both of new curricula to meet those needs, and of new and alternative delivery systems to improve the quality and effectiveness of instruction. Such explorations must be regarded as urgent.

5·1 IMPLICATIONS FOR EDUCATIONAL CONTENT

Educational policy should be directed at the future; it should not be formulated on the basis of present practice or past failures. As is to be expected, policy information increases in difficulty in proportion to the rapidity of technological change. At the very least, however, an education policy for the eighties must encompass the following:-

- vocational training to provide management and technical staff with relevant skills to exploit information technology in its various aspects;

- adult re-education and training programmes to cope with changing employment patterns resulting from the introduction of new technology;

- changes in contextual education to ensure that students at all levels are aware of information technology and its applications in society.

The development of information technology, particularly the widespread use of micro-computers, is changing the requirements for tertiary education, including TAFE, in this field. Courses relevant to the future must bring together elements of computing, electronics and telecommunications. As the technology matures, the degree of specialist skill needed to utilise it will decrease, providing greater opportunities for the technician. Both degree and technician level courses will need to incorporate the concepts of computing and programming techniques to a much greater extent than is now the case.

The new technology is already affecting the jobs of many people in the workforce. This trend is certain to continue and become more pronounced in the future, leading to much greater emphasis being placed on adult education and re-training programmes, and with a consequent increased demand for provision of the necessary training facilities.

In due course, information technology can also be expected to have a substantial impact on such basics of teaching as the 'three Rs'. According to the University of Sussex Report referred to above:

> "Arithmetic will be changed both because mechanical aspects of computation are eliminated and because the underlying concepts of programming are so basic to the thinking process that they should be introduced at an early age. Writing in its current form will be eliminated in favour of direct keyboard entry and editing, while reading will be enhanced, because the choice and access to information takes on an increasingly important role."

In the TAFE area many basic trade courses, adult literacy and numeracy programmes etc., will be similarly affected. Finally, and perhaps more pressingly, there will be an urgent need to develop broad-based programmes to educate about the new technology, in order to reduce the fear of the unknown that may otherwise afflict large sections of the community.

5·2 IMPLICATIONS FOR EDUCATIONAL METHODOLOGY

This paper has examined some of the ways in which the new information and communications technologies are currently being used in the learning/teaching process, and has suggested the possibility that they will be able to play a far more positive role in the future. It has also expressed the view that government and community pressures for a more cost-effective and educationally effective system of instruction will necessarily lead to a more technological approach to education in the coming decade.

The highly labour-intensive nature of the education industry, the high cost of technological hardware, and the virtual absence of suitable software, have been important obstacles inhibiting the adoption of this approach to

date. While salaries continue to rise, however, the cost of hardware is falling dramatically as products are developed for the mass market; at the same time, commercial companies are moving to create an educational market for quality instructional software. Dede estimates that "at the moment the cost of computer assisted instruction is decreasing 5% per year with about a 10% increase in productivity. As this trend is likely to continue and improve, a conservative estimate would be that in a decade these machines will be three times as productive as they are now and at one half the cost." (19)

Even now, according to Hitchens, "the economics of instructional media is not an issue for American industry, where training generally embraces technological approaches to instruction. The money expended each year for education and training by industry in this country (i.e. the U.S.) equals our national investment in public schools and colleges - about $90 billion." (20)

The adoption of technological approaches to education appears therefore to be inevitable - at least in the longer term - both for economic reasons and to provide the intensive, elaborate training needed to maintain a high-technology society. Negative influences, such as financial constraints on education authorities, resistance by teachers to the widespread use of technology, and lack of appropriate software in some fields may slow down the process for a time but are unlikely to block it permanently.

In these circumstances it is suggested that TAFE cannot afford to continue teaching today's curriculum by yesterday's methods for tomorrow's world. It must begin the process of planning now:

(a) to develop a systematic yet flexible approach to curriculum design and development;

(b) to further develop and improve the effective use of communications and information technology to deliver instruction;

(c) to introduce the necessary changes to both pre-service and in-service teaching training programmes to prepare teachers for a new and more demanding role;

(d) to provide new learning environments in TAFE Colleges;

(e) to expand the options available to adult learners through the provision of alternative delivery systems;

(f) to co-operate with other educational agencies as required to achieve the above aims.

(a) Systematic Approach to Curriculum Design

We have referred earlier to the Instructional Systems Model for Vocational Education which has been developed in Victoria (Sect. 2.2). This is "a dynamic curriculum approach which attempts to establish an educational system which is efficient and ensures that graduates are competent and satisfied in their working environment." It has built into it five basic phases - analysis, design, conduct, evaluation, and validation - and is sufficiently flexible to accommodate

changes as and when needed. It includes the selection of instructional strategies and the development of the necessary learning resources as key parts of the process.

The introduction of a systematic approach to curriculum design and development on these or similar lines is considered essential if the most effective use is to be made of physical facilities, equipment and human and material resources in the Department of Further Education.

(b) Technology and Instruction

The use of technology and media in education is neither inherently good nor bad, but neutral. Their effectiveness in the educational process depends more on those things which control the amount of learning from a teacher - relevance and clarity of content, skill of presentation, abilities, interest and motivation of the learner, etc. - than on media format. In general, any medium used in education should "be seen as a component of a teaching and learning system which works best when all the components of the system are well integrated and balanced." (21) - another argument for the systems approach.

This said, however, it is clear that we are now entering an era when for the first time the technical capability exists to transform all of education. The cost-effectiveness and feasibility of using instructional media and technology for improving learning and developing skills has been put beyond doubt in industrial, military and similar training environments. An important task now for TAFE and the Department of Further Education is to clearly distinguish between those areas in which machines may in future assume a direct instructional role - as in many training functions - and those in which a variety of learning resources can be used by a creative teacher to make the process of learning more individualised, more learner-centred, and hence more attractive to the student.

In the meantime, it is suggested that the development of educational technology within the Department should focus on:

(i) small scale, low cost applications in individual Colleges, involving teaching staff as fully as possible;

(ii) setting up educational technology units in selected Colleges, in association with the College LRC, to develop such applications and to serve as models for subsequent introduction in other Colleges;

(iii) evaluation and validation of existing departmentally produced learning resources and their use in College programmes;

(iv) trials of more sophisticated systems (e.g. computer based programmes) in selected courses in those Colleges with appropriate computing equipment.

(c) Teacher Training Programmes

The reluctance of many teachers to make use of technology in their teaching is well documented, and can be attributed to a variety of reasons: unfamiliarity with the applications of modern technology to

education; concern that the use of machines will dehumanise education; non-availability of the hardware or software when needed; scheduling difficulties; their own inability to operate the equipment, reluctance to experiment with new methods, etc. Whatever the reason, the apprehension of teachers must be overcome before any significant changes can be brought about in the methodology of education.

This will require corresponding changes in both pre-service and in-service teacher training programmes. The education technology component of existing methodology courses (e.g. in courses offered by the TAFE Department of the Adelaide College of the Arts and Education), which is already having some influence on the attitudes of recent graduates to the use of technology, will need to be further expanded, and to give greater emphasis to the underlying concepts of the educational systems approach and resource-based learning.

In-service training in these areas must receive a much higher priority than at present. It should be one of the principal functions of the educational technology units established in the larger Colleges, in conjunction with the D.F.E. Training and Development Centre and Educational Resources Branch, to develop on-going programmes for teaching staff, with the College itself acting as a learning laboratory; the teachers, like their students, will learn best by doing.

It is the view of this paper, that the Department of Further Education should seek the introduction of the modifications to teacher training programmes suggested above as soon as possible. It should also actively encourage a minimum number of its teaching staff (between 6 and 10 each year) to undertake the Graduate Diploma in Educational Technology at Salisbury C.A.E. This will provide the nucleus of qualified educational technologists needed to develop the new model of teaching and learning in Colleges of Further Education.

(d) New Learning Environments

New approaches to teaching and learning will require the provision of new learning environments. If students are going to spend a substantial part of their time working individually, and with some degree of independence from conventional instruction, they will need special facilities and work spaces systematically designed to facilitate independent learning, and access to modern information systems and multiple modes of communication. In turn these will need to be supported by an adequate supply of both conventional and programmed learning materials, and with a choice of options suited to the varied interests, abilities and learning needs of individual students.

These needs have found physical expression in the design of College Learning Resource Centres, which have replaced the traditional library in the majority of U.S. and Canadian community and junior Colleges, and in the past few years have made an appearance on some College campuses in South Australia - for example, Adelaide College of the Arts and Education at Underdale, Elizabeth Community College and Gilles Plains Community College, amongst others. The L.R.C. integrates traditional library services (such as circulation, reference and materials storage, and the associated cataloguing, processing and maintenance services) with media production and related instructional services. The latter may include learning laboratories (including

computer assisted learning), a learning assistance centre, instructional design and/or staff development services, and provision of off-campus learning resources.

Alternatively, some or all of these services may be located elsewhere on the campus.

Another example of a new learning environment is the computerised classroom, now being introduced in some Colleges in course areas such as accounting and banking where computerised systems are replacing the previous manual methods. With the great majority of accounting systems now computer-based, the development of computer-augmented training in these fields is essential if TAFE courses are to retain credibility with employers and professional associations. However, there are many other subject areas where computer assisted learning can be expected to play a major role in the coming years, with consequent implications for the provision and design of learning spaces in Colleges. The increasing use of video technology or ITV in its various forms will have similar effects.

Facilities planning for the Department of Further Education already takes account of these changing requirements for learning environments, and has incorporated them in the design of new Colleges such as those at Gilles Plains and Noarlunga. A more daunting task will be to plan the modification of existing College structures to enable the introduction and use of new methodology to proceed. Nevertheless, it is a task which must be addressed if TAFE in South Australia is to adjust successfully to the impact of technological change on industry and society in the foreseeable future.

(e) Alternative Delivery Systems

The new technologies have the potential to make learning truly universal - to bring about 'the learning society'. Human nature being what it is, there is little reason to believe that everyone will be equally eager to grasp at educational opportunities. Nevertheless, for those motivated to learn, it is now feasible to talk in terms of home learning centres as a possible future alternative to school or college. The electronic media and telecommunications will in course of time provide the means for the home to become a focus of learning. Direct satellite distribution of television and radio broadcasts and other data transmission systems will facilitate this development, as will the introduction of cable TV and interactive screened data technologies such as viewdata.

Realistically, the most probable outcome is that over time we shall gradually come to accept a broad spectrum of educational alternatives, with the traditional teaching institution at one extreme and the home at the other. In the meantime, an increasing demand can be expected for the extension of existing non-traditional systems and the further exploration of alternative forms of delivery by TAFE authorities.

It is likely that increasing use will be made of the mass media in extending TAFE programmes to those sections of the community that have remained outside the ambit of traditional courses. Non-formal community education programmes (such as those dealing with consumer affairs, family health and nutrition, and social welfare) are well adapted to

presentation on community radio (and perhaps in due course on community TV), particularly if 'talk-back' provision is also available. There is little doubt on overseas experience that local radio, whatever its defects, reaches audiences of would-be learners that may be small by broadcasting standards but are very substantial in terms of college enrolments in formal classes.

The Department of Further Education must not remain aloof from the developments taking place overseas and elsewhere in Australia. It is most important that it should monitor these developments, and assess their potential applications in its own programmes. It should then establish a continuing programme of educational trials, incorporating appropriate research design and evaluation methods to measure the educational and cost effectiveness of the particular delivery system. Where necessary, research and evaluation should be undertaken in conjunction with other authorities (see below).

There is immediate scope for field trials to be mounted in the following areas, all of which have considerable potential for future application:

(i) computer assisted learning and other forms of computer-based education;

(ii) delivery of educational services for adults in remote areas and country towns (including existing terrestrial and future satellite systems);

(iii) educational broadcasting and the adult learner.

As other technologies become available (for example, cable television, videodisc and viewdata) it will be necessary to initiate appropriate pilot studies to evaluate the potential of these systems for educational use.

(f) Co-operation with Other Agencies

The problems associated with the widespread introduction of the new technologies into education are such that no one authority or institution can be expected to cope with the changes unaided. Co-operative action will be required, both between states and between different sectors of education.

At the interstate level, the TAFE National Centre for Research and Development will provide an appropriate focus for co-operation between state TAFE authorities. The Centre's establishment will facilitate the development of 'common core' curricula in many trade and technical areas, and the corresponding development of resource materials at a national level to support these courses, rather than each state producing its own. It will also be able to undertake a range of research activities, including for example:-

(i) evaluative studies of the use of these materials in teaching programmes;

(ii) analysis of the cost and educational effectiveness of alternative teaching strategies and delivery systems;

(iii) identification of the main factors contributing to the effective and efficient use of resources and technology in TAFE programmes.

At the state level, it will be necessary to co-ordinate instructional development activities more closely with other institutions in the post-secondary sector. In an important paper (22) prepared for the Committee of Enquiry into Post-Secondary Education in South Australia (the Anderson Committee), Dr. Deane Hutton of Salisbury College of Advanced Education advocated the establishment of a Tertiary Instructional Development Centre to serve the Universities and CAEs, and which would have advisory and co-ordinating roles in the areas of course development, staff development and the development of instructional resources. He further suggested that the proposed Centre should establish informal links and channels of communication with the Department of Further Education and its relevant Branches (Curriculum Development; Training and Development; and Educational Resources).

No action seems to have been taken to implement Dr. Hutton's ideas and in any case a Centre of the type proposed is but one of a number of possible models. An alternative which could well merit consideration is the establishment of an Educational Communications Authority on similar lines to those set up by several Canadian provincial governments (e.g. Ontario and Alberta). TEASA would appear to be the logical authority to initiate a broad based feasibility study of the need for, and possible constitution and functions of, a Centre or Authority which could meet the growing needs of the tertiary sector in the related areas of instructional development and educational technology (in its production, utilisation and delivery aspects).

Finally, there is scope for co-operation with the Education Department in specific projects of mutual interest. An example is the possible participation by the Department of Further Education in the field trials via land line which the Education Department is currently conducting to assess the potential of satellite communications for educational purposes. As suggested in Section 3B.5, DFE could make use of the facilities and systems already developed by the Education Department, in order to test the delivery via satellite of educational services for adult students in remote areas and in country towns.

6. CONCLUSION

The main theme of this paper has been that the current view of educational technology and of its actual and potential applications in TAFE is too limited and too limiting. It further suggests that present developments in information technology (inter-relating micro-electronics, computing and communications), the plummeting fall in costs associated with its use, and its increasing reliability, will have pervasive effects throughout industry and society, with far greater impact on education than has been the case in the past. The importance of these developments for TAFE is summed up in no uncertain terms by Prof. John Bremer, Education Editor of "The Australian", in a special report published while this paper was being prepared (Aug. 27, 1980):

> "There is a need to think through the nature of vocational and technical training and the TAFE sector should adapt and re-organise itself in the light of changing social and industrial patterns. Whether its bureaucratic structure will allow it to do so is problematical.
>
> The move into a post-industrial era will have a shattering impact on TAFE, which is still essentially based on 19th century technology and the corresponding morals and values. Whether TAFE will be shattered or whether it will turn the impact to serve its own transformation remains to be seen."

It is imperative, therefore, that TAFE authorities such as the Department of Further Education should recognise the nature of the transformation taking place in technology and society, and as a matter of urgency plan to accommodate these changes in their educational programmes, curricula, and delivery systems. Planning is at the very heart of this process of adjustment. It needs to be undertaken in terms of the probable future rather than the present, which may well be the past by the time the plans are implemented.

We have said earlier that educational policy should be directed at the future. Planning relates policy to practice, and the planning process must ensure that developments in education and technology, the economy and society are kept under continuous review. In the approach to medium and long-term planning in particular, there is an on-going need to collect and analyse information from a variety of sources in order to provide new educational facilities, programmes and delivery systems relevant to changing individual and community needs.

The future lies with information technology. This technology will inevitably play a far more important role in education - both directly and indirectly - than has been the case in the past. The necessary planning for its introduction and integration into TAFE learning and teaching programmes must be given high priority and commenced without delay.

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